

CLAIMS

What is claimed is:

- 1 1. An acoustic logging tool that comprises:
 - 2 an acoustic source configured to excite wave propagation in a quadrapole mode;
 - 3 an array of acoustic receivers; and
 - 4 an internal controller configured to record signals from each of the acoustic receivers and
 - 5 configured to process the signals to determine a shear wave propagation slowness
 - 6 for a formation surrounding the acoustic logging tool.
- 1 2. The acoustic logging tool of claim 1, wherein the acoustic source is a quadrapole source.
- 1 3. The acoustic logging tool of claim 2, wherein the acoustic source includes four source
2 elements that are equally spaced about the circumference of the logging tool, and wherein
3 opposing elements are excited in-phase, and elements 90° apart are excited in inverse-phase.
- 1 4. The acoustic logging tool of claim 3, wherein each source element includes a piezoelectric
2 transducer.
- 1 5. The acoustic logging tool of claim 1, wherein the array of acoustic receivers includes a set of
2 four receiver elements at each of a plurality of positions along the longitudinal axis of the
3 logging tool, wherein the receiver elements of each set are equally spaced about the
4 circumference of the logging tool.

1 6. The acoustic logging tool of claim 5, wherein the acoustic source includes four source
2 elements that are equally spaced about the circumference of the logging tool, and wherein each
3 of the source elements is aligned with a respective one of the receiver elements in each set of
4 receiver elements.

1 7. The acoustic logging tool of claim 5, wherein the internal controller inverts signals from two
2 opposing receiver elements in each set of receiver elements and combines the inverted signals
3 with signals from the remaining two receiver elements in the set of receiver elements to obtain a
4 combined signal for each set of receiver elements.

1 8. The acoustic logging tool of claim 7, wherein each of the receiver elements includes a
2 piezoelectric transducer.

1 9. The acoustic logging tool of claim 1, wherein the internal controller is configured to determine
2 a phase semblance as a function of frequency and slowness from the receiver signals.

1 10. The acoustic logging tool of claim 9, wherein the internal controller is configured to identify
2 a phase semblance peak associated with each of a plurality of frequencies, and wherein the
3 internal controller is configured to identify a smallest slowness value associated with the phase
4 semblance peak as the shear wave propagation slowness for the formation.

1 11. The acoustic logging tool of claim 1, wherein the tool is configured for logging while
2 drilling.

1 12. The acoustic logging tool of claim 1, wherein the source excites waves having frequencies
2 greater than 2 kHz.

1 13. A method of determining the shear wave propagation slowness of a formation, the method
2 comprising:

3 exciting waves that propagate along a borehole in quadrapole mode;

4 receiving acoustic signals at each of a plurality of positions along the borehole; and

5 calculating, from the acoustic signals, slowness values associated with a peak phase

6 semblance as a function of frequency.

1 14. The method of claim 13, wherein the peak phase semblance is associated with a borehole
2 interface wave.

1 15. The method of claim 13, further comprising:

2 determining a minimum slowness value associated with the peak phase semblance.

1 16. The method of claim 15, further comprising:

2 providing the minimum slowness value as an estimate of the shear wave propagation

3 slowness.

1 17. The method of claim 13, further comprising:

- 2 processing the acoustic signals to enhance the quadrapole response of a receiver array
- 3 before said act of calculating slowness values.

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